

## **Application of eddy currents for inspection of carbon fibre composites**

Rylan Gomes<sup>1</sup>, Ehsan Mohseni<sup>1</sup>, S. G. Pierce<sup>1</sup>, Kenneth Burnham<sup>1</sup>, Charles MacLeod<sup>1</sup>, Vedran Tunukovic<sup>1</sup>, Euan Foster<sup>1</sup>, Tom O'Hare<sup>2</sup>, Gavin Munro<sup>3</sup>.

<sup>1</sup> *SEARCH: Sensor Enabled Automation, Robotics & Control Hub, Centre for Ultrasonic Engineering (CUE), Department of Electronic & Electrical Engineering, University of Strathclyde, Royal College Building, 204 George Street, Glasgow G1 1XW, [rylan.gomes@strath.ac.uk](mailto:rylan.gomes@strath.ac.uk)*

<sup>2</sup> *Spirit AeroSystems Belfast, Airport Road, Belfast, Co. Down, Northern Ireland, BT3 9DZ*

<sup>3</sup> *Spirit AeroSystems, Aerospace Innovation Centre, Glasgow Prestwick Airport, Monkton, KA9 2RW*

Carbon Fibre Reinforced Plastics (CFRP) have diverse industrial applications due to their unique mechanical and structural properties. The manufacturing cycle of CFRP can be summarised into three stages: Preforming, moulding and post cure. During the preforming stage of the composites where there is cutting, handling and layup of carbon fibre fabrics, defects such as fibre waviness, missing bundles and in-plane waviness can occur. These defects are usually detected when the component is inspected after the post cure stage. Hence there is a need to inspect these components before the resin is infused into the dry layup. Currently there is no standardised NDE protocols for the inspection of these dry fabrics and preforms in the aerospace manufacturing industry. This study investigates the inspection of Dry Carbon Fabrics (DCF) for fibre orientation, density, and defects such as missing fibre bundles, in and out of plane fibre waviness, before the resin infusion manufacturing stage, using Eddy Current Testing (ECT).

Initial experiments were conducted to test the penetration depth of eddy currents in DCF. A sample was built using biaxial fibre cloth with fibre orientation at 0° and 90°. Six layers were used where layers 2,3,4 and 5 had a strip of aluminium foil to detect the penetration depth of eddy currents through the sample. A total of four stripes were used within the sample. The inspection was carried out at frequencies of 500 and 800 kHz using an eddy current array probe attached to a KUKA robotic arm. Data was gathered in absolute mode for pairs of transmit-receive coils in two transversal and axial topologies. The scans displayed all four stripes, indicating that the eddy current had penetrated through all six layers at both test frequencies. To identify the sensitivity to internal defects, a second experiment was conducted. The inspection sample was made by stacking 10 sheets of DCF with a piece of preformed carbon fibre to induce fibre waviness. Initial results show that the waviness can be detected at 500 kHz with a strong accuracy in every repetition of the scans. Orientation of the fibres could not be detected at this frequency.

To conclude, initial experiments were conducted on dry carbon fibre fabrics using eddy current testing to detect fibre waviness and penetration depth of eddy currents. The results show an indication of fibre waviness in a 10-layer sample at 500 kHz in every repetition of the scans. Although the orientation of the fibres could not be detected at this frequency.